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RESEARCH IN TRANSITION

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USING INFORMATION ON RELATIVES TESTED IN BOTH STATIONS AND HERDS TO INDEX PERFORMANCE-TESTED BULLS

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The bull-test programme has been in operation in Ontario for almost 20 years using the Record of Performance (ROP) index to evaluate bulls by means of their average daily gain while they are on test. The index is calculated as a deviation from a breed-adjusted average for a contemporary group of animals weighted by the number of sons per sire.

When the index was introduced, it reflected current evaluation procedures and available data and was a simple, effective method of evaluating bulls. Nonetheless, there have been several specific aspects of the ROP index which have been of concern. One is that bulls are evaluated on a phenotypic (body type as it develops in relation to its environment) rather than on a genetic level. Second, breed adjustments used in the index calculation are assumed to be known and accurate. Third, a random distribution of genotypes among test groups is assumed in order to allow for comparisons across test stations. Finally, the index does not consider the fact that bulls are likely selected to be put in the test stations or that there are carry-over effects from the environment in which these animals grew up.

With the expansion of the programme, a great deal of information on related individuals became available which could be of use in evaluations. Expected progeny differences (EPD's), which incorporate information on related individuals, and correlated traits can now be used to give accurate genetic evaluations and address the problems outlined above. Advances in statistical analysis could also be used to improve the system.

OBJECTIVES OF THE RESEARCH

There were two main objectives in launching this study:

1. to examine the problems which were felt to exist in the present system with regard to selection and pre-test carry-over from the animals' environment; and
2. to develop and compare improved procedures for evaluating the growth rate of performance-tested bulls.

DESIGN AND PROCEDURES

Records of 11,285 bulls which were performance-tested between 1970 and 1985 in Ontario and Manitoba stations were used. Of these, 1,152 were of Aberdeen Angus bulls, 1,977 of Charolais, 4,636 of Hereford, 759 of Limousin, 1,157 of Shorthorn, and 1,604 of Simmental.

The selection of bulls, on the basis of average daily gain to weaning, for station testing was examined within herds using t-test procedures.

A Best Linear Unbiased Prediction (BLUP) approach was used to produce a genetic evaluation based on test station average daily gain. This procedure takes into account the genetic merit of other bulls in the test group and increases the accuracy of evaluation by incorporating information on paternal half-sibs.

A two-trait BLUP evaluation was also used which considered information on average daily gain in the test station and the genetically correlated trait of average daily gain to weaning. This was included to take into account the selection of bulls which were put into the test stations and the carry-over of effects from the animals' previous environment.

The four evaluation systems based on the BLUP animal model which were compared were:

1. single trait (test station average daily gain) incorporating paternal half-sibs;
2. two trait (pre-test and on-test average daily gain) incorporating paternal half-sibs;
3. single trait incorporating paternal half-sibs and maternal grandsires; and,
4. two trait incorporating paternal half-sibs and maternal grandsires.

The inclusion of information on maternal grandsires would further enhance the accuracy and allow for the evaluation of maternal and direct effects on performance up to weaning.

A linear model was used to describe the trait of average daily gain to weaning. This contained the effects of herd year, age at weaning (both linear and quadratic), and the additive genetic value.

The model for the test station average daily gain included the test group in place of the herd year as a fixed effect. The age covariates were omitted since a preliminary analysis found that age at the end of test had no significant effect on the trait.

EPD's for each bull were obtained from each BLUP evaluation, and correlations between the different methods and between these methods and the ROP index were computed.

SUMMARY OF THE RESULTS

Table 1. Correlations between pre-test and on-test average daily gain

	CORRELATIONS
Phenotypic	.03
Genetic	.49
Environmental	−.19

When the available data were examined, the results substantiated the concerns about the selection of bulls and the carry-over effects of the environment the animals were in before the test. There was evidence that bulls were selected on the basis of their phenotypic performance up to weaning. The phenotypic, genetic, and environmental correlations between the pre-test and the on-test average daily gain are given in Table 1.

The low, but significant, negative environmental correlation between the two traits implies a negative association between the effects of the pre-weaning and the on-test environments. This lends support to the questions about carry-over and compensatory gain. Drastically lowering the start of the age at which bulls go on test and/or extending the adjustment period would help to reduce the degree of carry-over; however, under the Ontario cow-calf system, these are hardly practical measures. The problems can be taken care of statistically through the use of the two-trait model.

The single-trait BLUP approach produces a genetic evaluation which is more accurate than the ROP index. This is the case because of the statistical procedures used and the inclusion of information on related animals, that is, paternal half-sibs. Including information on the correlated trait ADG-W to produce a two-trait evaluation increases accuracy still further by accounting for selection and carry-over effects. If information on the maternal grandsire is also added in, the accuracy is enhanced even further, and both direct and maternal EPD's for performance to weaning can be estimated. Table 2 gives the correlations between the various evaluation systems.

Table 2. Correlations between the ROP Index and EPD's for test station average daily gain estimated using various BLUP procedures

BLUP PROCEDURE	ROP INDEX
Single Trait	.90
Single Trait with Maternal Grandsires	.89
Two-Trait	.85
Two-Trait with Maternal Grandsires	.84

The correlation of 0.84 with the two-trait MGS model shows that the ROP index has been a useful means of evaluating bulls. Nevertheless, the relative accuracy of the evaluation can be increased by about 15% with the use of the two-trait model. Unfortunately at the moment, restrictions on data preclude the use of information on maternal grandsires in the proposed system of evaluation under consideration for use in the Ontario bull test programme.

THE SIGNIFICANCE OF THE NEW MODEL FOR THE INDUSTRY

If EPD's for tested bulls, derived from the two-trait BLUP model, were used, it would eliminate inaccuracies in the ROP index due to selection of calves which are going on test and of non-random sets of calves in test groups. EPD's would also increase accuracy by considering paternal half-sibs and by taking pre-test environment into consideration. The expected increase in relative accuracy of 15% would be reflected in an increased genetic response to existing selection programmes. In the long run, this would increase producers' returns as well.